Visualization of Landscape Changes in a 3D Environment using the Storytelling Approach - the Example of the City of Pristina

Festina Sadiku
Outline

• Introduction and motivation
• Research objective
• Methodology
• Results
• Conclusion and outlook
Introduction and motivation
Visualizing landscape changes encourage users in understanding and comparison of the past with the present.\(^1\)

Objects with more than three dimensions can be used to model geographical phenomena.\(^2\)

Maps are good to represent a geographic space but text have a better benefit than maps for telling a story.\(^3\)
Thesis motivation

No map, interactive animation, visualization or 3D model is existing for the City of Pristina.

Thesis aim

Drafting a 3D model with a lightshow on top of it to visualize and tell the story of the landscape change of the City of Pristina.
Research objective

The main objective of this thesis is to investigate how textual descriptions about landscape changes can be transferred and attractively communicated in a 3D model using the storytelling method.

RO1 Visualization of textual descriptions using storytelling method.

RO2 Evaluation of the effectiveness of the visualization (3D model and projection).
Research questions

**R01** Visualization of textual descriptions using storytelling method.

**RQ1.1** How are the landscapes changes revealed in textual descriptions?

**RQ1.2** How can the textual descriptions transferred into a spatial model?

**RQ1.3** Which further datasets are needed for the creation of a 3D model and what further storytelling elements are beneficial for projection in order to visualize landscape?
Research questions

**RQ2**

Evaluation of the effectiveness of the visualization (3D model and projection).

**RQ2.1**

Is a projection (lightshow) on top of a 3D model an attractive opportunity to visualize landscape changes?

**RQ2.2**

Can the user see the changes through time in this visualization?
Methodology
Visualization in 2D

Methods to visualize the spatial-temporal change in 2D:
• 2D map(s)
• 2D satellite image(s)
• Animation
• Overlay
• Highlighting

Figure 1. Maradona marsh.
Visualization in 3D

Methods to visualize the spatial-temporal change in 3D:

- 3D map(s)
- 3D (Photorealistic) model(s)
- Space-time cube(s)
- Overlay

Figure 2. City of Olomuc.
Visualization in 4D

Methods to visualize the spatial-temporal change in 4D:

- 3D model(s)
- Animation
- Satellite image(s)
- Sound (voice)
- Time series

Figure 3. Stolen heart video map.
Visualizations in virtual, mixed and augmented reality

Methods to visualize the spatial-temporal change in VR, MR and AR:

- Space-time cube
- 3D model(s)
- Photorealistic image(s)

Figure 4. Royal Castle of Warsaw.

Modelling the cultural historical objects

Figure 5. Steps on modeling cultural objects.
### Dimension of reality, map and Cura, scale 1:500

<table>
<thead>
<tr>
<th>Objects</th>
<th>Dimension of reality (m)</th>
<th>Scale 1:500</th>
<th>Dimension on map (cm)</th>
<th>Dimension on Cura Software (mm)</th>
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<td>X</td>
<td>Y</td>
<td>Z</td>
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<td>30</td>
<td>28</td>
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<td>2</td>
<td>10</td>
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<td>70</td>
<td>71</td>
<td>(40/500)*100</td>
</tr>
<tr>
<td>Assembly</td>
<td>71</td>
<td>132</td>
<td>25</td>
<td>(71/500)*100</td>
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<tr>
<td>Garshe Mosque</td>
<td>21</td>
<td>20</td>
<td>45</td>
<td>(21/500)*100</td>
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<tr>
<td>Brotherhood and Unity</td>
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<td>3</td>
<td>17</td>
<td>(2.5/500)*100</td>
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<tr>
<td>Museum of Kosovo</td>
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<td>25</td>
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<tr>
<td>Clock Tower</td>
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<td>5</td>
<td>26</td>
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### Objects with the required time and material

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<th>Time consuming</th>
<th>Material consuming</th>
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<td>20 gram</td>
</tr>
<tr>
<td>Union</td>
<td>2h 48min</td>
<td>19 gram</td>
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<tr>
<td>Skanderbeg</td>
<td>5min</td>
<td>0.03 gram</td>
</tr>
<tr>
<td>Ibrahim Rugova</td>
<td>5min</td>
<td>0.05 gram</td>
</tr>
<tr>
<td>Government</td>
<td>10h 15min</td>
<td>17 gram</td>
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<tr>
<td>Assembly</td>
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<td>93 gram</td>
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<td>4h 25min</td>
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<td>Brotherhood and Unity</td>
<td>15min</td>
<td>0.03 gram</td>
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<tr>
<td>Museum of Kosovo</td>
<td>1h 42min</td>
<td>14 gram</td>
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<tr>
<td>Clock Tower</td>
<td>1h 18min</td>
<td>2 gram</td>
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Printing the 3D model

- Ibrahim Rugova statue
- Skanderbeg statue
- Brotherhood & Unity
- Clock Tower
Government

Museum of Kosovo

National Theater

Union

Assembly

Qarshia Mosque
CNC engraving road modeling

Figure 6. Engraving road model.
Textual Data Collection

1. Overview of landscape change in general

2. Detailed research to all 10 buildings

3. Buildings following the same storyline:
   - Year of construction
   - Year for remodeling
   - The main characteristics of the monuments
   - Architect or designer
   - How it is used the monuments

4. Highlighting method

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### Preparation of Additional Datasets

- **Cadastral Plan**
- **Orthophotos**
- **Borders of Pristina**
- **Archival Images**
- **Textual Data**
- **Audio**

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<th>Year</th>
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<td>Sheradon Sylejmani</td>
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Creating the Projection

Figure 8. Elaboration of the first phase: Introduction.

Figure 9. Elaboration of the third phase: evolving city by orthophoto.

Figure 10. The final stage of projection.
Figure 11. Prototype with sequences taken from animation.
Results
The exhibition setup

Amphitheater of the University of Pristina
1st - 3rd September 2021

Equipment available:
- 3D models of the buildings
- Wooden base plate
- Video projectors ACER X1323WH to project the lightshow
- Anker Sound Core 2 Portable for the sound (voice and music)
User group

- 20 valid cases
- Different professional backgrounds
- Different prior knowledge
User’s prior knowledge (1)

Do you know any cultural monuments at Mother Theresa and Zahir Pajaziti boulevard in Prishtina?

Have you ever worked with 2d, 3d, 4d, or with virtual reality mixed and augmented in your work?
User’s prior knowledge (2)

How informed do you feel about the most cultural monuments on Mother Teresa and Zahir Pajaziti Boulevards in Prishtina?

- Less informed
- Neutral
- Informed
- Very Informed

Which kind of maps have you worked in order to represent landscape changes?

- 2D maps
- 3D maps
- 4D maps
- Maps in virtual, mixed and augmented reality
- Web 2D+time
"It is very interesting and very accurate. The reason for the reply "good" is since I am an architect by profession and I have traveled a lot outside Kosovo, I am aware of 3D models that represent the change of a place or a storytelling with time-series for a certain event. The advantage of the models I have seen is that they have used a larger space and have displayed more objects, more animation."
User’s responses

Which sort of information is presented in the prototype

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

Information about the city
Information about monuments
Information about streets
Information about the change of the city

Do you think each element of the animation helps you understanding the landscape change?

- Not at all
- Neutral
- Very much

Textual information
Audio
Cadastral maps
Orthofotos
User’s suggestions

Would you design a similar prototype, what would you add?

- More 3D buildings
- More textual information
- More audio
- More cadastral maps
- More orthofotos

- Not at all
- Not at all
- Neutral
- Neutral
- Very much
User’s memorization

Name buildings that were represented in the year of 1893

- "Union"
- Sahat Kulla
- Xhamia e Carshise
- Muzeu i Kosoves

Name the newest, oldest building represented in the model

- Not remembered
- Remember
User’s difficulty level (1)

Reading the textual information was:

- Easy: 12
- Moderate: 4
- Difficult: 2

Combination of textual information with audio was:

- Very useful: 18
- Useful: 4
- Not useful: 2
User’s difficulty level (2)
Conclusion and outlook
Visualization of textual descriptions using storytelling method.

Multimedia is the key element of interactive storytelling used to represent and transfer textual descriptions in a spatial model.

The text is one element in the narrative approach and mainly supports the visualization by providing additional information on the most important landscape changes with the categorization of features.

Data sets needed for visualizing landscape changes are text, audio, cadastral maps, and orthophotos, archival images.
RO2 Evaluation of the effectiveness of the visualization (3D model and projection).

Majority of users found the combination of textual descriptions an attractive solution for describing the landscape changes.

The time series elements helped users see the visualization of changes through the time approach in storytelling.

Users stated that the model looked accurate, attractive, and the combination of materials was pleasing.
The methods and techniques used are a recommendation for similar cities that have overcome a similar landscape change but not for cities or areas that have a different type of landscape change.

Through the visualization of textual description, storytelling aims to represent landscape change in action through time and to draw attention to the participant.

Multimedia is the key element of interactive storytelling.
The implementation of this idea in another city would be the determination of the smallest scale so that the space is larger and the presentation of the elements would happen more often. Frequent animation presentations would make storytelling more realistic and more emotional.

- Different scale,
- Adding more 3D models,
- Evaluation with further participants.
Thank you for your time.